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Applicant(s)	:	MICROFIBRES, INC., ET AL.
Title	:	SYSTEMS AND METHODS FOR AIR EMBOSSING FABRICS UTILIZING IMPROVED AIR LANCES
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RESPONSE TO WRITTEN OPINION
AMENDMENT UNDER PCT ARTICLE 34(2)(b)

This is in response to the Written Opinion dated 13 April 2001. In response to the Written Opinion, Applicants wish the International Preliminary Examining Authority to take into account the attached amendments under PCT Article 34(2)(b) of the specification and claims. Please substitute the enclosed sheets labeled as pages 3-7, 7/1, 7/2, 27, and 44-61 for original pages 3-7, 27, and 44-62 and consider the pages filed herewith to establish the International Preliminary Examination Report.

In the Specification

The following changes have been made to the specification:

On page 3, the paragraph beginning at line 24 is replaced with the following paragraph:

-- In one embodiment, a system for air embossing a surface of an embossable fabric is disclosed. The system comprises a stencil having a first surface and a second, fabric-facing surface that is positionable adjacent and in spaced proximity to the embossable surface of the fabric during air embossing. The system further comprises an air lance comprising a main body portion and including at least one nozzle. The nozzle is constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface. The air lance is secured within the system to maintain the nozzle in a fixed, predetermined position relative to the first surface of the stencil during operation. The air

lance is positioned such that the nozzle is positioned so that at least a portion thereof, which is closest to the stencil, is separated from the first surface of the stencil by a first distance, when the system is in operation. The air lance is also positioned such that the smallest distance separating the main body portion of the air lance from the first surface of the stencil exceeds the first distance. --

On page 4, the paragraph beginning at line 1 is replaced with the following paragraph:

-- In another embodiment, a system for air embossing a surface of an embossable fabric is disclosed. The system comprises a stencil and an air lance including at least one nozzle thereon. The nozzle is constructed and positioned to direct a flow of air through the stencil and onto the embossable surface of the fabric, when the system is in operation. The system further comprises a substantially smooth support surface comprising a cylindrical roller constructed and arranged to support the underside of the fabric during air embossing of the embossable surface of the fabric with the system. The cylindrical roller is positioned directly beneath and spaced apart from the nozzle such that a stream of air exiting the nozzle is directed to impinge upon the fabric at a location where the fabric is adjacent to and in contact with the cylindrical roller, when the system is in operation. --

On page 4, the paragraph beginning at line 10 is replaced with the following paragraph:

-- In another aspect, an air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric is disclosed. The air lance comprises a conduit having at least one opening therein and at least one orifice forming at least one nozzle. The nozzle is constructed and positioned to direct a stream of air through the stencil and onto the embossable surface of the fabric when the air lance is in operation. The nozzle has a characteristic orifice dimension not exceeding about 0.05 inch. --

On page 4, the paragraph beginning at line 23 is replaced with the following paragraph:

-- In yet another embodiment, an air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric is disclosed. The air lance comprises a conduit having an elongated main body portion with at least one inlet opening and at least one outlet opening therein. The air lance further includes a nozzle-forming

component connected to the main body portion and extending along a substantial fraction of the length of the main body portion. The nozzle-forming component includes at least one orifice therein forming a nozzle. The nozzle is in fluid communication with the outlet opening of the main body portion and is constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface of the fabric when the air lance is in operation. The nozzle-forming component is shaped and positioned so that the nozzle in the nozzle-forming component is separated from a first surface of the stencil onto which air is impinged by a distance that is substantially less than a distance separating the first surface of the stencil and the outlet opening in the main body portion of the conduit. -

On page 5, the paragraph beginning at line 3 is replaced with the following paragraph:

-- In yet another embodiment, an air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric is disclosed. The air lance comprises an elongated tubular conduit having at least one inlet opening therein and at least one internal support strut attached therein. The support strut is constructed and positioned within the conduit to resist expansion of the conduit when the air lance is in operation. The air lance includes at least one orifice in the shape of an elongated slit forming at least one nozzle. The nozzle is constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface of the fabric, when the air lance is in operation. --

On page 6, the paragraph beginning on line 4 is replaced with the following paragraph:

-- In yet another embodiment, a method for embossing a surface of an embossable fabric is disclosed. The method comprises supplying a flow of air to an air lance, flowing a stream of air through at least one nozzle of the air lance so that the velocity of the air exiting the nozzle is at least about 12,000 ft/min, passing the stream of air through at least one opening in the stencil, impinging the stream of air onto the embossable surface of the fabric, and embossing the embossable surface of the fabric with a predetermined pattern of embossed features. --

On page 6, the paragraph beginning at line 10 is replaced with the following paragraph:

-- In another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises supplying a flow of air to an air lance, flowing a stream of air through at least one nozzle of the air lance, rotating a cylindrical stencil disposed around at least a portion of the air lance at a first speed, passing the stream of air through at least one opening in the rotating stencil, moving the fabric adjacent to an outer surface of the stencil at a second speed that is different from the first speed of the rotating stencil, impinging the stream of air onto the embossable surface of the fabric, and embossing the embossable surface of the fabric with a predetermined pattern of embossed features. --

On page 6, the paragraph beginning at line 18 is replaced with the following paragraph:

-- In another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises positioning at least a portion of at least one nozzle of an air lance within a first separation distance from a first surface of a stencil, positioning a main body portion of the air lance so that the smallest distance separating the main body portion from the first surface of the stencil exceeds any distance separating the nozzle from the first surface of the stencil, forming a stream of air with the air lance by passing air through the nozzle of the air lance, and directing the stream of air through at least one opening in the stencil and onto the embossable surface of the fabric to form a predetermined pattern of embossed features. --

On page 6, the paragraph beginning at line 23 is replaced with the following paragraph:

-- In yet another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises positioning a substantially smooth support surface comprising a cylindrical roller directly beneath and spaced apart from the nozzle of the air lance. The method further comprises supporting the underside of the embossable fabric with the cylindrical roller and directing a stream of air with the nozzle through a stencil and onto the embossable surface of the fabric such that the stream of air impinges upon the fabric at a location where the fabric is adjacent to and in contact with the cylindrical roller. --

On page 6, the paragraph beginning at line 30 is replaced with the following paragraph:

-- In yet another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises directing a stream of air though a stencil and onto the embossable surface of the fabric with an air lance including a conduit, having at least one inlet opening therein, and at least one orifice forming at least one nozzle having a characteristic orifice dimension not exceeding about 0.05 inch. --

On page 7, the paragraph beginning at line 7 is replaced with the following paragraph:

-- In yet another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises directing a stream of air through a stencil an onto the embossable surface of the fabric with an air lance including a conduit, and a nozzle forming component including at least one orifice therein forming a nozzle that is in fluid communication with the outlet opening in the main body portion. The nozzle forming component is shaped and positioned to extend along a substantial fraction of the length of the main body portion and so that the nozzle in the nozzle forming component is separated from a first surface of the stencil, onto which the stream of air is impinged, by a distance that is substantially less than a distance separating the first surface of the stencil and the outlet opening in the main body portion of the conduit. --

On page 7, line 17, the following two paragraphs are inserted:

-- In another embodiment, a method for embossing a surface of an embossable fabric is disclosed. The method comprises directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including an elongated tubular conduit. The conduit has at least one inlet opening therein, at least one internal support strut attached therein, which support strut is constructed and positioned within the conduit to resist expansion of the conduit when the air lance is in operation, and at least one orifice in the shape of an elongated slit forming at least one nozzle.

In yet another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including a conduit, the air lance having at least one inlet opening therein, at least one orifice forming at least one nozzle, and at least one air redirecting element constructed and positioned with respect to the nozzle so

that the fractional amount of the stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric is increased with respect to a fractional amount of a stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element. --

On page 27, line 14, "226" is deleted and -- 225 – has been inserted therefore.

The above changes to the specification represent the correction of a minor typographical error and changes to the summary of the written description so as to make it consistent with the language of amended independent claims, in accordance with Rule 5.1(a)(iii) PCT.

No new matter has been added.

In the Claims

Claims 1-112 are now pending in the application. Original claim 1 is replaced by amended claim 1. Original claims 2-9 are replaced by amended claims 2-9. Original claim 21 is replaced by amended claim 21. Original claim 26 is replaced by amended claim 26. Original claim 30 is replaced by amended claim 30. Original claims 31 and 32 have been cancelled, without prejudice. Original claims 33-35 have been renumbered as claims 31-33 and amended to change their dependency. Original claims 36-40 have been renumbered as claims 34-38. Original claims 41-55 have been renumbered as claims 39-53 and amended to change their dependency to reflect renumbering. Original claim 56 has been amended and renumbered as claim 54. Original claims 57-79 have been renumbered as claims 55-77 and amended to change their dependency to reflect renumbering. Original claim 80 has been amended and renumbered as claim 78. Original claims 81 and 82 have been renumbered as claims 79 and 80. Original claims 83-95 have been renumbered as claims 81-93 and amended to changed their dependency to reflect renumbering. Original claim 96 has been cancelled, without prejudice. Original claim 97 has been amended and renumbered as claim 94. Original claims 98-100 have been renumbered as claims 95-97 and amended to change their dependency to reflect renumbering. Original claim 101 has been amended and renumbered as claim 98. Original claims 102-105 have been renumbered as claims 99-102 and amended to change their dependency to reflect renumbering. Original claims 106 and

107 have been cancelled, without prejudice. Original claim 108 has been renumbered as claim 103. Original claim 109 has been amended and renumbered as claim 104. Original claim 110 has been amended and renumbered as claim 105. Original claim 111 has been amended and renumbered as claim 106. Original claim 112 has been renumbered as claim 107. Original claim 113 has been amended and renumbered as claim 108. Original claim 114 has been amended and renumbered as claim 109. Original claim 115 has been renumbered as claim 110. New claims 111, which depends from claim 1, and 112, which depends from claim 104, have been added. A marked-up copy of the claims illustrating the amendments and changes is attached as an appendix for the Examiner's convenience.

Amendments to claims 1 and 104 (previously claim 109) recite subject matter illustrated, for example, in Figs. 4b, 5, 8a-c, and 8c and disclosed in the specification on, for example, pages 21-28, 32, and 39. Amendments to claims 26 and 105 (previously claim 110) recite subject matter illustrated, for example, in Figs. 4c and 5 and disclosed in the specification on, for example, pages 23 and 24.

Amendments to claims 54 (previously claim 56) and 108 (previously claim 113) recite subject matter illustrated, for example, in Figs. 8a-b and disclosed in the specification on, for example, pages 26 and 27.

Amendments to claims 78 (previously claim 80) and 109 (previously claim 114) recite subject matter illustrated, for example, in Figs. 5, 7a-d, 8a-c, and 8e and disclosed in the specification on, for example, pages 27 and 38.

Amendments to claims 94 (previously claim 97), 98 (previously claim 101), and 104 (previously claim 109) recite subject matter illustrated in, for example, Figs. 4a-b and disclosed in the specification on, for example, pages 10, 16, 17, and 19-21.

No new matter has been added.

REMARKS

In response to the Written Opinion dated 13 April 2001, the applicants request reconsideration of the application in view of the accompanying amendments and remarks.

The individual sections of the Written Opinion will now be addressed, with reference to the section numbering in the Written Opinion.

Concerning Section V

Objection to claims 1-4, 14-17, 26, 27, 56, 82, 96-105, 109, 110, and 113 as lacking novelty under PCT Article 33(2) as being anticipated by Minemura et al., U.S. Patent No. 4,497,095 (D1)

Reconsideration is requested of the objection to claims 1-4, 14-17, 26, 27, 56 (now renumbered as claim 54), 82 (now renumbered as claim 80), 96-105 (now renumbered as claims 94-102, with claim 96 having been cancelled), 109 (now renumbered as claim 104), 110 (now renumbered as claim 105), and 113 (now renumbered as claim 108) as lacking novelty under PCT Article 33(2) as being anticipated by Minemura et al. (D1). In general, in all the remarks below (this section and those following), the claims will be referred to by their current numbering, unless otherwise indicated.

Regarding claim 1, nowhere is it observed where D1 discloses or suggests an air embossing system where an air lance of the system for air embossing a surface of an embossable fabric is secured in the system to maintain the nozzle in a fixed, predetermined position relative to the first surface of the stencil during operation, as recited in claim 1 (as amended). By contrast, the high pressure liquid distribution header **12** disclosed in D1 is configured to reciprocate within rotating cylinder **2** during operation (see column 5, lines 17-22 and 48-51), and, therefore, D1 cannot anticipate claim 1 (as amended). Moreover, the reciprocation of the header as disclosed in D1 is important for enabling the system of D1 to produce an extremely random pattern of nap reorientation, which is the disclosed purpose of the invention of D1 (see column 4, lines 39-4). Accordingly, the objection to claim 1 as lacking novelty over D1 has been overcome, and reconsideration is respectfully requested. Claims 2-4 and 14-17 depend from and include all the limitations of claim 1, and cannot be anticipated by D1 for at least the reasons stated above in regard to claim 1; therefore, reconsideration of the objection of these claims as lacking novelty over D1 is also respectfully requested.

Regarding claim 26, nowhere is it observed where D1 discloses or suggests a system for air embossing a surface of an embossable fabric that includes a substantially smooth support surface comprising a cylindrical roller constructed and arranged to support the underside of the fabric during air embossing, as recited in claim 26 (as amended). By contrast, cylindrical fabric support roll **16** disclosed by D1 includes a fabric supporting surface having thereon a random pattern of contour variation on its surface, which random pattern of contour variation is essential to creating D1's desired random nap fiber

reorientation effect (see Figs. 1A-1D; column 2, lines 19-23; column 3, lines 4-21, 38-45; and column 4, lines 30-38 and 44-48). Accordingly, the fabric support rolls disclosed in D1 do not have a substantially smooth support surface, and, therefore, the disclosure of D1 cannot anticipate claim 26 (as amended). Accordingly, the objection to claim 26 as lacking novelty over D1 has been overcome, and reconsideration is respectfully requested. Claim 27 depends from and includes all of the limitations of claim 26 and cannot be anticipated by D1 for at least the reason stated above in regard to claim 26; therefore, reconsideration of the objection of this claim as lacking novelty over D1 is also respectfully requested.

Regarding claim 56 (now renumbered as claim 54) nowhere is it observed where D1 discloses or suggests an air lance comprising a conduit having an elongated main body portion and a nozzle forming component connected to the main body portion that extends along a substantial fraction of the length of the main body portion, as recited in claim 54 (as amended). By contrast, high pressure liquid header **12** of D1 includes a plurality of individual nozzles **14**, positioned at discrete locations on the header. None of the nozzles disclosed in D1 comprises a nozzle forming component that extends along a substantial fraction of the length of a main body portion of an air lance of the system, as recited in claim 54 (as amended). Accordingly, D1 cannot anticipate claim 54 (as amended) so that the objection to claim 54 as lacking novelty over D1 has been overcome, and reconsideration is respectfully requested..

Regarding claim 82 (now renumbered as claim 80), nowhere is it observed where D1 discloses or suggests a method for air embossing a surface of an embossable fabric which includes a step of flowing a stream of air through at least one nozzle of an air lance so that essentially the entire stream of air is directed towards a surface of a stencil at an angle of at least about 45° with respect to the longitudinal axis of the air lance, as recited in claim 80. In fact, nowhere is it observed where D1 discloses any particular angular orientation of the fluid streams emitted from the nozzles of the system of D1 with respect to the longitudinal axis of the high pressure liquid header. In addition, those skilled in the art, upon reading the disclosure of D1, would conclude that directing a fluid stream through a nozzle towards the surface of the stencil such that the entire liquid stream makes an angle of at least about 45° with respect to the longitudinal axis of the liquid header would be undesirable. Specifically, D1 discloses that it is preferred to shape the spout of the nozzles included in the system as a

cone or sector in order to produce a diverging, conical or sectoral spray formation (see column 4, lines 10-14). One would reasonably expect that such diverging spray patterns would typically include at least a component of the spray directed at angles less than about 45° with respect to the longitudinal axis of the high pressure liquid header. Accordingly, it is believed that D1 does not anticipate the method recited in claim 80. Therefore, the objection to claim 80 as lacking novelty over D1 has been traversed, and reconsideration is respectfully requested.

Regarding claim 97 (now renumbered as claim 94) nowhere is it observed where D1 discloses or suggests a method for air embossing a surface of an embossable fabric comprising a step of embossing the embossable surface of the fabric with a predetermined pattern of embossed features, as recited in claim 94 (as amended). By contrast, the systems and methods disclosed in D1 are configured for producing a suede-like random reorientation of the nap on the surface of a raised fabric and not a predetermined pattern of embossed features (see column 4, lines 43-48 and column 5, lines 35-39). Accordingly, D1 cannot anticipate claim 94 (as amended). Therefore, the objection to claim 94 as lacking novelty over D1 has been overcome, and reconsideration is respectfully requested. Claims 98-100 (now renumbered as claims 95-97) depend from and include all of the limitations of claim 9 and are novel in view of D1 for at least the reasons stated above in regard to claim 94; therefore, reconsideration of the objection of these claims as lacking novelty over D1 is also respectfully requested.

Regarding claim 101 (now renumbered as claim 98), as with claim 94 discussed above, nowhere is it observed where D1 discloses or suggests a method for air embossing a surface of an embossable fabric comprising a step of embossing the embossable surface of the fabric with the predetermined pattern of embossed features as recited in claim 98 (as amended). Accordingly, the objection to claim 98 as lacking novelty over D1 has been traversed, and reconsideration is respectfully requested. Claims 102-105 (now renumbered as claims 99-102) depend from and include all of the limitations of claim 98, as amended, and are novel in view of D1 for at least the reasons stated above with respect to claim 98, and, therefore, reconsideration is requested of the objection of these claims as lacking novelty over D1.

Regarding claim 109 (now renumbered as claim 104), as discussed above with regard to claims 94 and 98, nowhere is it observed where D1 discloses or suggests a method for air embossing a surface of an embossable fabric comprising a step of directing a steam of air through at least one opening and a stencil and onto an embossable surface of the fabric to form a predetermined pattern of embossed features, as recited in claim 104 (as amended). Accordingly, the objection to claim 104 as lacking novelty in view of D1 is believed to be overcome, and reconsideration is respectfully requested.

Regarding claim 110 (now renumbered as claim 105), nowhere is it observed where D1 discloses or suggests a method for air embossing a surface of an embossable fabric comprising step of positioning a substantially smooth support surface comprising a cylindrical roller directed beneath and spaced apart from a nozzle of an air lance. As discussed above in the context of the comments made with regard to claim 26, the support roll of D1 does not have a substantially smooth support surface, but rather includes thereon a plurality of randomly positioned, shaped, and sized topological features. Accordingly, the objection to claim 105 as lacking novelty over D1 is believed to be overcome, and reconsideration is respectfully requested.

Regarding claim 113 (now renumbered as claim 108), nowhere is it observed where D1 discloses or suggests a method for air embossing a surface of an embossable fabric comprising a step of directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including a conduit, having a main body portion, and a nozzle forming component including at least one orifice therein forming a nozzle, which is positioned to extend along a substantial fraction of the length of the main body portion, as recited in claim 108 (as amended). As discussed above in the context of the comments made with regard to claim 54, the nozzles disclosed in D1 comprise individual nozzles positioned at discrete locations on the high pressure liquid header and do not comprise a nozzle forming component shaped and positioned to extend along a substantial fraction of the length of the main body portion of an air lance. Accordingly, it is believed that the objection to claim 108 as lacking novelty over D1 has been overcome, and reconsideration is respectfully requested.

Objection to claims 30-32, 36, 38, 40-51, 80, 82, 96, 111, 112, and 114 as lacking novelty under PCT Article 33(2) as being anticipated by Halloran U.S. Patent No. 3,916,823 (D2)

Reconsideration is requested of the objections to claims 30-32, 36 (now renumbered as claim 34), 38 (now renumbered as claim 36), 40-51 (now renumbered as claims 38-49), 80 (now renumbered as claim 78), 82 (now renumbered as claim 80), 96, 111 (now renumbered as claim 106), 112 (now renumbered as claim 107), and 114 (now renumbered as claim 109) as lacking novelty under PCT Article 33(2) as being anticipated by Halloran U.S. Patent No. 3,916,823 (D2).

Regarding claim 30, nowhere is it observed where D2 discloses or suggests an air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric comprising a nozzle having a characteristic orifice dimension not exceeding about 0.05 inch, as recited in claim 30 (as amended). By contrast, the smallest nozzle size disclosed in D2 is 0.0625 inch. Accordingly, the disclosure of D2 cannot anticipate claim 30 (as amended), and the objection to claim 30 as lacking novelty in view of D2 is believed to be overcome, and reconsideration is respectfully requested. Claims 36 and 38 (now renumbered as claims 34 and 36) depend from and include all of the limitations of claim 30, as amended, and are novel in view of D2 for at least the reasons stated above in regard to claim 30, and reconsideration is respectfully requested. Moreover, nowhere is it observed where D2 discloses an air lance including a nozzle having a characteristic orifice dimension not exceeding a maximum characteristic length of the nozzle as recited in claim 34.

Regarding claim 40 (now renumbered as claim 38), as discussed above with regard to claim 34, nowhere is it observed where D2 discloses or suggests an air lance for directing air through a stencil and onto the surface of an embossable fabric for air embossing the fabric comprising a nozzle having a characteristic orifice dimension not exceeding a maximum characteristic length of the nozzle. Nowhere is it observed where D2 discloses, either explicitly or inherently, any particular values for the maximum characteristic length of any of the disclosed nozzles. Accordingly, D2 cannot explicitly or inherently anticipate the air lance recited in claim 38. Based on the above remarks, it is believed that the objection to claim 38 as lacking novelty over D2 has been traversed, and reconsideration is respectfully requested. Claims 41-51 (now renumbered as claims 39-49) depend from and include all the limitations of claim 38 and are believed to be novel in view of D2 for at least the reasons stated above with regard to claim 38, and, therefore, reconsideration is respectfully requested. Moreover, nowhere is it observed where D1 discloses the particular ratios of nozzle characteristic length

to characteristic orifice dimension recited in claims 39-41, or a nozzle in the shape of an elongated slit having a width that varies along the length of the main body portion of the air lance such that the width is greatest in a region of the slit closest to the first end of the conduit forming the air lance and smallest in the region of the slit closest to the second sealed end of the conduit as recited in claim 47.

Regarding claim 80 (now renumbered as claim 78), nowhere is it observed where D2 discloses or suggests an air lance comprising an elongated tubular conduit having at least one internal support strut attached therein, which is constructed and positioned within the conduit to resist expansion of the conduit when the air lance is in operation. Therefore, D2 cannot anticipate claim 78 (as amended). Accordingly, the objection to claim 78 as lacking novelty in view of D2 is believed to be overcome, and reconsideration is respectfully requested.

Regarding claim 82 (now renumbered as claim 80), nowhere is it observed where D2 discloses or suggests flowing a stream of air through a nozzle of an air lance so that essentially the entire stream of air is directed towards a surface of a stencil facing and adjacent the nozzle at an angle of at least about 45° with respect to the longitudinal axis of the air lance. D2 is silent regarding the performance of their air distributing tubes in this respect, and the designs taught, for example slots or holes formed in sidewall of a thin-walled conduit, would not be expected to inherently provide such performance. Accordingly, it is believed that the objection to claim 80 as lacking novelty in view of D2 has been traversed, and reconsideration is respectfully requested.

Regarding claim 111 (now renumbered as claim 106), nowhere is it observed where D2 discloses or suggests a method for air embossing a surface of an embossable fabric comprising a step of directing a stream of air with an air lance including at least one nozzle therein having a characteristic orifice dimension not exceeding about 0.05 inch, as recited in claim 106 (as amended). As discussed above in the comments regarding claim 30, the smallest nozzle size as disclosed by D2 is 0.0625 inch. Accordingly, it is believed that the objection to claim 106 as lacking novelty over D2 has been overcome, and reconsideration is respectfully requested.

Regarding claim 112 (now renumbered as claim 107), nowhere is it observed where D2 discloses or suggests a method for air embossing a surface of an embossable fabric comprising a step of directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including at least one orifice forming at least one nozzle having a characteristic orifice dimension not exceeding a maximum characteristic length of the nozzle, as recited in claim 107. As discussed above in the context of the comments made with regard to claim 38, neither the characteristic nozzle length nor the relationship between the characteristic nozzle length and a characteristic orifice dimension of a nozzle is disclosed, either explicitly or inherently, or suggested in D2. Accordingly, it is believed that the objection to claim 107 as lacking novelty in view of D2 has been traversed, and reconsideration is respectfully requested.

Regarding claim 114 (now renumbered as claim 109), nowhere is it observed where D2 discloses or suggests a method for air embossing a surface of an embossable fabric comprising a step of directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including an elongated tubular conduit having at least one internal support strut attached therein, which support strut is constructed and positioned within the conduit to resist expansion of the conduit when the air lance is in operation, as recited in claim 109 (as amended). Accordingly, it is believed that the objection to claim 109 as lacking novelty over D2 has been overcome, and reconsideration is respectfully requested.

Objection to claims 5-13, 28, 29, 84, and 85 as lacking an inventive step under PCT Article 33(3) as being obvious over (D1)

Reconsideration is respected of the Examiner's objection to claims 5-13, 28, 29, 84 (now renumbered as claim 82), and 85 (now renumbered as claim 83) as lacking an inventive step under PCT Article 33(3) as being obvious in view of (D1).

Regarding claims 5-13, the Written Opinion asserts that D1 teaches the air embossing system including an air lance substantially as claimed, including a nozzle-stencil distance of 0.12 inch and a stencil fabric distance of 0.08 inch. The Written Opinion further asserts that it would have been obvious to a skilled artisan to have optimized these distances.

Applicants disagree. To begin with, each of claim 5-13 depends from and includes all of the limitations of independent claim 1 (as amended). Accordingly, if claim 1 is patentable in view of D1 then claims 5-13 are also patentable in view of D1. As discussed previously,

nowhere is it observed where D1 discloses a system for air embossing including an air lance that is secured within the system to maintain the nozzle(s) in a fixed, predetermined position relative to a first surface of the stencil during operation. Accordingly, as discussed above, claim 1 (as amended) cannot be anticipated by the disclosure D1. Moreover, D1 provides no suggestion or motivation to one of ordinary skill in the art to modify the disclosed system so that the disclosed header is secured to maintain the nozzles in a fixed, predetermined position relative to a first surface of the stencil during operation. In contrast, also as discussed above, the reciprocating motion of the high pressure liquid header disclosed in D1 is important to enabling the system of D1 to effect the desired random of reorientation of the nap on the raised fabric being embossed. Modifying the high pressure liquid header disclosed in D1 so that it is secured within the system to maintain the nozzles at a fixed, predetermined position relative to a first surface of the stencil during operation would serve to decrease the randomness of the reorientation of the fabric surface in D1 and render the system more poorly suited to perform its intended function of forming an extremely random reorientation of the nap on the surface of the treated fabric. Thus, D1 effectively teaches away from securing an air lance within an air embossing system such that the nozzle(s) is in a fixed, predetermined position relative to the first surface of the stencil during operation, as recited in claim 1 (as amended). Accordingly, claim 1 (as amended) is believed to patentably distinguish D1, and, therefore, claims 5-13 also patentable distinguish D1, for at least the reasons stated above with regard to claim 1.

In addition, the applicants disagree with the Examiner's position that, in view of the disclosure of D1, it would have been obvious to the skilled artisan to reduce the nozzle-stencil distance and stencil fabric distance disclosed by D1 to satisfy the specific limitations recited in claims 5-13. The applicants point out that the distance as recited in the above-mentioned claims are each substantially below the minimum values of the ranges for such distances as disclosed in D1. Moreover, D1, for each of the above-disclosed distances, teaches separation distances varying over an extremely wide range (e.g. 0.3 to 30 cm for the nozzle-stencil distance and 0.2 to 20 cm for the stencil-fabric distance; see column 4, lines 18-22). Such extremely wide ranges would suggest to those of ordinary skill in the art that these distances are not particularly critical and would provide no motivation to those of ordinary skill in the art to decrease these distances to values substantially below the minimum values recited in D1.

Regarding claims 28 and 29, each of these claims depends from and includes all the limitations of independent claim 26 (as amended). Accordingly, if claim 26 (as amended) patentably distinguishes D1, then claims 28 and 29 must also patentably distinguish D1. As discussed previously, nowhere is it observed where D1 discloses or suggest a system for air embossing a surface of an embossable fabric that includes a substantially smooth support surface comprising a cylindrical roller constructed and arranged to support the underside of the fabric during air embossing of the embossable surface of the fabric with the system, as recited in claim 26 (as amended). Furthermore, there would be absolutely no motivation for those of ordinary skill in the art to modify the randomly and unevenly profiled surface of the fabric support roller disclosed in D1 to have a substantially smooth surface. Specifically, D1 teaches that the randomly and unevenly profiled surface of the fabric support roller is critical for enabling the system of D1 to perform its intended function of forming a random reorientation of the nap on the surface of a treated fabric (see, for example, column 4, lines 30-48). D1, therefore, effectively teaches away from modifying the fabric support roller to have a substantially smooth support surface. In view of the above remarks, it is believed that claim 26 (as amended) is not obvious in view of D1, and, therefore, that claims 28 and 29, dependent on claim 26, are also not obvious in view of D1, and reconsideration is respectfully requested.

Furthermore, the applicants also disagree with the assertion made in the Written Opinion that it would have been obvious to those of ordinary skill in the art to have provided support roll **16** of D1 with a conventional scraper blade cleaning element in order avoid fabric unevenness on the support roll. To begin with, because the surface of the support roll of D1 is disclosed as having a plurality of features projecting from the surface (see Figs. 1A-1D), it is not understood how a conventional scraper blade cleaning element could even be effective at cleaning the contoured surfaces of support roll **16** disclosed in D1. Moreover, the Written Opinion points to avoiding fabric unevenness on the support roll as a motivation for providing a conventional scraper blade cleaning element; however, as disclosed in D1, fabric "unevenness" on the support roll is an important feature of the system enabling the formation of the desirable random reorientation of the nap on the surface of the fabric being treated.

Regarding claims 84 and 85 (now renumbered as claims 82 and 83), each of these claims depends from and includes all of the limitations of independent claim 80 (formerly claim 82), thus, these claims are patentably distinguished over D1 if independent claim 80

patentably distinguishes D1. As discussed previously, nowhere is it observed where D1 discloses or suggests a method for air embossing a surface of an embossable fabric comprising a step of flowing a stream of air through at least one nozzle of an air lance so that essentially at the entire stream of air is directed towards a surface of a stencil at an angle of at least about 45° with respect to a longitudinal axis of the air lance, as recited in claim 80. As discussed previously, D1 neither explicitly nor inherently discloses or suggests directing a stream of air through any of the nozzles provided in the system of D1 so that essentially the entire stream of air is directed towards the surface of the stencil at an angle of at least about 45° with respect to a longitudinal axis of an air lance. In view of the above, it is believed that claim 80 patentably distinguishes D1, and, therefore, that claims 82 and 83, which depend on claim 80, also patentably distinguish D1. Moreover, nowhere is it observed that D1 suggests or motivates the nozzle-stencil distance recited in claim 82 or the air flow velocity recited in claim 83. In view of the above, reconsideration of the objection of claims 82 and 83 as lacking an inventive step in view of D1 as respectfully requested.

Objection to claims 18-22, 57-62, 86-91, 106, and 107 as lacking an inventive step under PCT Article 33(3) as being obvious over (D1) in view of (D2)

Reconsideration is requested of the objections to claims 18-22, 57-62 (now renumbered as claims 55-60), 86-91 (now renumbered as claims 84-89), 106, and 107 as lacking an inventive step under PCT Article 33(3) as being obvious over (D1) in view of (D2).

The Written Opinion asserts that D1 teaches the air embossing methods and systems including an air lance substantially as claimed in the above-mentioned claims, except for explicitly disclosing the nozzle orifice dimension. The Written Opinion further asserts that D2 discloses an air embossing method and system including an air lance, wherein the nozzle orifice may be an elongated slit having a width of 0.0625 inch (which the Written Opinion, without citing any supporting disclosure of D2, asserts is less than the nozzle length). The Written Opinion goes on to assert that it would have been obvious to a skilled artisan to have modified the air lance of D1 with the nozzle orifice disclosed in D2, and that it also would have been obvious to optimize the slit width.

Applicants disagree. Neither D1 nor D2 provide any suggestion or motivation to combine the references along the line suggested in the Written Opinion. On the contrary, those of ordinary skill in the art would not be motivated to combine the teachings of D1 and

D2 nor to modify the high pressure liquid header disclosed in D1 along the lines suggested in the Written Opinion.

To begin with, the methods and systems disclosed in D1 and D2 are described as being configured to work on very different types of fabric. Specifically, the methods and systems of D1 are disclosed as being configured to texturize raised woven or knitted fabrics (see column 1, line 6-14 of D1), and not flocked pile fabrics having pile fibers adhered to a surface via an uncured, deformable adhesive. By contrast, D2 discloses that its systems and methods are limited to use for patterning flocked pile fabrics wherein the pile is secured to the substrate, during the air embossing process, by a binder that is flexible or deformable (see column 2, lines 14-20 and 49-52 of D2). Accordingly, those of ordinary skill in the art, based upon the above disclosures, would not expect that the systems of D2 would be well suited for modifying the fabrics or performing the methods which are the subject of D1, and, therefore, would not look to D2 to modify and improve the embossing systems and methods of D1. In addition, the disclosure of D2 is strictly limited to air embossing. While D1 does disclose that high pressure air can be utilized in the context of the systems and methods disclosed in D1, D1 also clearly indicates that the use of air is not preferred (see column 4, lines 10-11 of D1). The fact that D1 is directed primarily to a high pressure water/steam embossing systems and methods and D2 is exclusively directed to an air embossing system and method would further direct those of ordinary skill away from combining the two references along the lines suggested in the Written Opinion.

Furthermore, the systems and methods disclosed in D1 and D2 are designed to create a completely different embossed fabric surface effect. Specifically, the systems and methods of D1 are configured to produce a subtle, extremely random reorientation of the nap of the surface of the raised fabrics being texturized, which random rearrangement being characterized by a low degree of outline sharpness of the embossed regions (see, for example, column 1, lines 46-51 and column 4, lines 43-48 of D1). By contrast, the systems and methods of D2 are designed and configured to produce a predetermined pattern of visually distinct embossed features (see column 1, lines 52-62 of D1). Those of ordinary skill in art, even if they were motivated to modify the system disclosed in D1 for some reason, would not be motivated to look to the system of D2, which is configured and designed for producing a completely different type of surface texturing inconsistent with the primary purpose of the system of D1, namely producing a random and subtle reorientation of nap on the surface of treated fabrics.

In addition, substitution of the nozzles disclosed in D1 with a nozzle orifice in the form of an elongated slit as disclosed in D2, along the lines suggested in the Written Opinion, would render the system of D1 more poorly suited for producing the desired random nap orientation and, therefore, there would be no motivation for those of ordinary skill in the art to make such a substitution of modification. Specifically, the high pressure liquid header disclosed in D1 includes a plurality of individual nozzles thereon, which are reciprocated within the stencil cylinder so as to enable the individual liquid jets emitted from the nozzles to more randomly and irregularly intercept/interact with the various apertures in the stencil to effect a more random pattern of liquid impinging upon the surface of the fabric, thus resulting in a more random pattern of reorientation of the nap of the fabric. Should the individual nozzles of the high pressure liquid header be replaced with a single elongated slit-shaped nozzle as suggested in the Written Opinion, because the distribution of fluid emitted from such nozzle would be continuous and relatively uniform across the entire width of the fabric and stencil (e.g. see column 5, lines 19-25 of D2), reciprocation of the high pressure liquid header would be rendered essentially ineffective for creating a more random distribution of nap orientation, since reciprocation of the header would have essentially no tendency to alter the interaction of the fluid emitted from the nozzle with the apertures in the stencil. Accordingly, substitution of a slit-shaped nozzle for the plurality of individual nozzles disclosed in D1 would render the disclosed reciprocation of the high pressure liquid header in D1 essentially inoperative for performing its intended purpose.

Also, D1 discloses that it is preferred that the nozzles for use in the systems and methods described be shaped to form a diverging conical or sectoral spray formation (see column 4, lines 10-14 of D1). By contrast, the disclosure of D2 teaches that their system is designed and configured to produce a precise air flow pattern, which avoids diffusion or dispersion (see column 5, lines 28-33 of D2). Therefore, in view of the disclosure in D1 that nozzles forming divergent flow patterns are preferred in the context of the disclosed systems and methods, those of ordinary skill in the art would not look to substitute the nozzles of D2, which are configured to maintain a precise air flow pattern avoiding diffusion and dispersion, to modify the systems of D1.

Based on the above remarks, it is believed that combination of D1 and D2, as suggested in the Written Opinion, is improper and that the above objections to the claims as lacking an inventive step in view of the combination of D1 and D2 cannot be maintained, and, therefore, reconsideration is respectfully requested.

Moreover, even if one of ordinary skill in the art were to attempt to combine D1 and D2 along the lines suggested in the Written Opinion, nowhere is it observed where D1 or D2, alone or in combination, teach, suggest, or motivate a nozzle having a characteristic orifice dimension not exceeding a maximum characteristic length of the nozzle, as recited in claim 19; a nozzle forming component connected to a main body portion of an air lance that extends along a substantial fraction of the length of the main body portion, as recited in claim 54 (formerly claim 56) (as amended) (from which claims 57-62 (now renumbered as claims 55-60) depend); an air lance including a nozzle-forming component having at least one orifice comprising an elongated slit that is essentially parallel to an elongated slot in the main body portion of the air lance, as recited in claim 58 (now renumbered as claim 56); an air lance having a slot in a main body portion thereof that exceeds the width of a slit in a nozzle forming component, as recited in claim 59 (now renumbered as claim 57); an air lance including a nozzle forming component that is elongated and is disposed over a slot in the main body portion of the air lance so that the slit in the nozzle forming component and the slot in the main body portion are essentially coextensive, as recited in claim 60 (now renumbered as claim 58); an air lance wherein the length of a nozzle region of the nozzle forming component as measured along a direction parallel to the longitudinal axis of a main body portion of the air lances is at least as great as the width of the fabric being embossed by the air lance, as recited in claim 61 (now renumbered as claim 59); an air lance including a nozzle-forming component including a hollow chamber upstream from an essentially coextensive with an elongated slit forming a nozzle of the nozzle-forming component, as recited in claim 62 (now renumbered as claim 60); a method for air embossing a surface of an embossable fabric comprising a step of flowing a stream of air through at least one nozzle of an air lance so that essentially the entire stream of air is directed towards a surface of a stencil at an angle of at least about 45° with respect to a longitudinal axis of the air lance, as recited in claim 80 (formerly claim 82), upon which objected to claims 86-91 (now renumbered as 84-89) depend; or a method for embossing a surface of a fabric including steps of passing a stream of air through at least one opening in a stencil and impinging the stream of air onto the embossable surface of the fabric wherein during the impinging step at least a portion of the fabric-facing surface of the stencil is positioned from the embossable surface of a fabric at a distance not exceeding about 0.02 inch, as recited in claim 87 (now rewritten as claim 85).

Objection to claims 23-25, 63-79, and 92-95 as lacking an inventive step under PCT Article 33(3) as being obvious over (D1) in view of (D2) and further in view of Marco et al., U.S. Patent No. 5,202,077 (D3)

Reconsideration is requested of the objection to claims 23-25, 63-79 (now renumbered as claims 61-77), and 92-95 (now renumbered as claims 90-93) as lacking an inventive step under PCT Article 33(3) as being obvious over D1 in view of D2 and further in view of D3.

The Written Opinion asserts that the above-mentioned claims are obvious over D1 and D2 as applied in the Section immediately above, further in view of D3. The Written Opinion asserts that D3 teaches a fabric treating method and system including an air lance which includes an air redirecting element for directing pressurized air at right angles to the fabric. The Written Opinion further asserts that it would have been obvious to a skilled artisan to have utilized the air redirecting element of D3 in the air embossing system of D1 in order to ensure that the pressurized air from the air lance is directed perpendicularly to the fabric surface.

It is believed that the present objection to the above-mentioned claims, since it relies on the combination of D1 and D2 shown to be unsupportable in the Section immediately above, cannot be maintained, and reconsideration and withdrawal of the objection of the above-claims on the present basis is respectfully requested. Furthermore, the applicant disagrees that it would have been obvious to the skilled artisan to utilize the air redirecting element of D3 in the embossing system of D1, as suggested in the Written Opinion. The motivation provided in the Written Opinion is that the skilled artisan would have utilized the air redirecting element of D3 for the purpose of ensuring that pressurized air from the distribution header of D1 is directed perpendicularly to the fabric surface. However, as discussed above, D1 explicitly teaches that divergent conical or sectoral shaped spray formations, which by their very nature include substantial components thereof not directed perpendicularly to the fabric surface, are preferred for use in the system and methods disclosed in D1. Accordingly, skilled artisans seeking to modify the systems and methods of D1 would not find motivation disclosed in any of the references cited in the Written Opinion to increase the fraction of fluid emitted from the nozzles of D1 that is directed perpendicularly to the fabric surface. The teaching of D1 itself, as referred to immediately above, effectively teaches away from such a modification. The applicants assert that the only motivation to incorporate an air redirecting element in an air lance utilized for air embossing

fabric for the purpose of increasing the fractional amount of a stream of air directed through a stencil essentially perpendicular to an embossable surface of the fabric being embossed comes from the teaching of applicants' specification. Such a motivation, based in hindsight upon reading the applicants' specification, is not a proper basis for establishing obviousness or lack of inventive step.

Objection to claims 81, 108, and 115 as lacking an inventive step under PCT Article 33(3) as being obvious over (D1) in view of (D3)

Reconsideration is rejected of the objection to claims 81, 108, and 115 (now renumbered as claims 79, 103, and 110, respectively) as lacking an inventive step under PCT Article 33(3) as being obvious over D1 in view of D3.

Similar to the objection immediately above, the present objection in the Written Opinion asserts that D1 teaches the air embossing method and system essentially as claimed except for an air redirecting element in the air lance nozzle. The Written Opinion asserts that D3 discloses a fabric treating method and system including an air lance which includes an air redirecting element for directing the pressurized air at right angles to the fabric. The Written Opinion then asserts that it would have been obvious for a skilled artisan to have utilized the air redirecting element of D3 in the air embossing system of D1 in order to ensure that the pressurized air from the air lance is directed perpendicularly to the fabric surface.

As discussed above in the context of the previous objection, because the disclosure of D1 itself effectively teaches away from "ensuring" that pressurized fluid from an air lance is directed perpendicularly to the fabric surface, and because the only motivation the applicants observe for modifying D1 along the lines suggested in the Written Opinion appears to be derived in hindsight from the applicants' own specification, it is believed that the present objection of the above claims also cannot be maintained. Accordingly, reconsideration and withdrawal of the objection is respectfully requested.

Objection to claims 33-35 as lacking an inventive step under PCT Article 33(3) as being obvious over (D2)

Reconsideration is requested of the Examiner's objections to claims 33-35 (now renumbered as claims 31-33) as lacking an inventive step under PCT Article 33(3) as being obvious over D2.

The Written Opinion asserts that D2 teaches an air lance substantially as claimed, including a nozzle slot width of 0.0625 inch. The Written Opinion further asserts that it would have been obvious to a skilled artisan to optimize the slot width in order to improve the embossing effect on the fabric surface.

Applicants disagree. Nowhere is it observed where D2 teaches or suggests that the smallness of the nozzle characteristic dimension is critical or important to performance of the air lance for embossing fabrics. Nowhere is it observed where D2 suggests that decreasing the slot width or nozzle orifice characteristic dimension would be reasonably expected to improve performance of the air lance in the systems and methods disclosed by D2. Therefore, the skilled artisan, in view of well known practical difficulties and expense of forming nozzles having very small characteristic orifice dimensions, would not be motivated to further reduce the minimum nozzle orifice dimension (i.e. 0.0625 inch) disclosed by D2. In view of the remarks above, it is believed that the present objection to the above-mentioned claims has been traversed, and reconsideration is respectfully requested.

Objection to claims 37 and 55 as lacking an inventive step under PCT Article 33(3) as being obvious over D2 in view of D1

Reconsideration is requested of the objections to claims 37 and 55 (now renumbered as claims 35 and 53) as lacking an inventive step under PCT Article 33(3) as being obvious over D2 in view of D1.

The Written Opinion asserts that D2 teaches an air lance substantially as claimed, except for a nozzle-forming component on the air lance body. The Written Opinion further asserts that D1 teaches an air lance having nozzle-forming components **14** on an air lance body **12**, and that it would have been obvious to a skilled artisan to have utilized such nozzle-forming components in D2 in order to facilitate repair or replacement of the nozzles.

Applicants disagree. For essentially the same reasons as stated above in the context of the comments made with regard to the claim objections based on the combination of D1 in view of D2, it is believed that those of ordinary skill in the art would not be motivated to combine the teachings of D2 and D1 or to look to D1 for the purpose of modifying the systems and methods of D2. As pointed out above, the systems and methods of D1 and D2 are disclosed as being configured for operating on entirely different fabrics and producing entirely different surface embossing effects.

In addition to the reasons stated previously concerning the reasons why those of ordinary skill in the art would not combine the teachings of D1 and D2, the applicants also refute the position taken in the Written Opinion that it would have been obvious to a skilled artisan to have utilized the nozzle-forming components of D1 in the system of D2 for the purpose of facilitating repair or replacement of the nozzles. To begin with, nowhere is it observed where D2 or D1 disclose or suggest that the nozzles of either air distribution tube **128** of D2 or high pressure liquid header **12** of D1 require more frequent repair or replacement than the tube or header itself. Accordingly, there is no motivation provided or suggested in the disclosures of either D1 or D2 leading those of ordinary skill in the art to add to the mechanical complexity of the D2 air lance by incorporating nozzle forming components.

Furthermore, the Written Opinion points to repair and replacement of the nozzles as forming the motivation for incorporating nozzle-forming components on the air tube of D2; however, nowhere is it observed where D1 discloses or suggests that nozzles **14** are either detachable or replaceable. It appears that a primary motivation in D1 to provide nozzles 14 extending from header **12** is to enable the nozzles to be formed with a spout creating a divergent spray (see column 4, lines 12-14 of D1). Such purpose, however, would teach away from use of nozzles 14 in the systems and for the methods taught by D2, where diffusion or divergence of the air stream is described as undesirable (see column 5, lines 30-32 of D2).

In view of the above remarks, it is believed that, contrary to the assertions and the Written Opinion, those skilled in the art would not be motivated to look to D1 for the purpose of modifying the air distribution tube disclosed in D2. Accordingly, it is believed that the objection to the above claims on the present grounds has been traversed, and reconsideration is respectfully requested.

Furthermore, even if one of ordinary skill in the art were to combine D1 with D2 as suggested in the Written Opinion, such combination will still not satisfy all of the limitations of the above-mentioned claims. Specifically, nowhere is it observed where D2 or D1, alone or in combination, disclose, suggest, or motivate an air lance including a nozzle having a characteristic orifice dimension not exceeding about 0.05 inch, as recited in claim 30 (as amended), upon which claim 35 (formerly claim 37) depend; or an air lance including a nozzle having a characteristic orifice dimension not exceeding a maximum characteristic

length of the nozzle as recited in claim 38 (formerly claim 40), upon which claim 53 (formerly claim 55) depends.

Objection to claims 39, 52-54, 108, and 115 as lacking an inventive step under PCT Article 33(3) as being obvious over (D2) in view of (D3)

Reconsideration is requested of the objections to claims 39 (now renumbered as claim 37), 52-54 (now renumbered as claims 50-52), 108 (now renumbered as claim 103), and 115 (now renumbered as claim 110) as lacking an inventive step under PCT Article 33(3) as being obvious over D2 in view of D3.

The Written Opinion asserts that D2 teaches an air lance substantially as claimed, except for an air redirecting element in the nozzle. The Written Opinion further asserts that D3 teaches an air lance having an air redirecting element in the nozzle, and that it would have been obvious to a skilled artisan to have utilized the air redirecting element of D3 in the air lance of D2 in order to ensure that the pressurized air from the air lance is directed perpendicular to the fabric surface.

Applicants disagree. Because the systems, methods, and purposes disclosed in D3 are fundamentally different than those disclosed in D2 and because utilization of the air redirecting element of D3 (i.e. shim plate **73**) in the system of D2 would render the system essentially inoperative for performing its intended purpose, it is believed that the objection of the above claims, based upon the combination of D2 and D3, cannot be maintained.

As discussed previously, D2 is directed to air embossing systems and methods for air embossing a flocked pile fabric, with a flock binder in a plastic or flexible state, by directing air through a patterned stencil in order to produce an embossed flocked pile fabric having a predetermined pattern of air embossed regions thereon. The system of D2 utilizes a rotating stencil having a surface with a predetermined pattern of apertures corresponding to the desired predetermined pattern of air embossments on the air embossed fabric. Within the stencil disclosed by D2 is disposed an air distribution tube **128** including one or more nozzles distributed across the width of the fabric and stencil in order to provide a what is asserted to be a relatively uniform distribution of air across the entire width of stencil and fabric (e.g. see Figs. 2, and 3-5 and column 5, lines 22-25 of D2).

By contrast, the disclosure of D3 is directed to systems and methods for impinging high temperature pressurized streams of fluids against the surface of fabrics or other substrates for the purpose of melting and removing material from substrates to produce

recessed channels in the substrates that facilitate separation of the materials (see the Abstract of D3). The systems and methods disclosed in D3 do not involve directing air through a stencil (the system of D3 does not utilize a stencil) to produce an embossed pattern on a fabric, which is the sole purpose of the systems and methods disclosed in D2; rather, the purpose of the systems and methods of D3 is to melt grooves into a substrate to facilitate separation of the substrate into multiple pieces - a purpose and function which has absolutely nothing to do with the purpose and function of the systems disclosed in D2. Because the purpose, function, and structure of the systems disclosed in D2 and D3 are so different, one skilled in the art would not be motivated to look to D3 for the purpose of modifying the systems or methods disclosed in D2. This is especially so in view of the fact that the motivation given in the Written Opinion for modifying D2 to incorporate the air redirecting element disclosed in D3, namely in order to ensure that the pressurized air from tube **128** of D2 is directed perpendicularly to the fabric surface, is nowhere observed to be disclosed in D2 as being important to the performance of the air embossing systems/methods. The applicants believe that the only disclosure teaching the importance of redirecting air emitted from an air lance so as to increase the fractional amount of an air stream directed through a stencil that is essentially perpendicular to the embossable surface of the fabric for air embossing the fabric comes from the applicants' own specification. As previously mentioned, it is improper to utilize the teachings of the applicants' own specification to formulate, in hindsight, a motivation for combining references in the prior art for the purpose of arguing that the applicants' claims are obvious in view of such combination.

Yet another reason why those skilled in the art would not be motivated to incorporate the air redirecting element disclosed in D3 in the system of D2 is that the narrow, widely spaced, discrete streams of air created by the air redirecting element of D3 (see column 5, lines 14-23 and column 6, lines 41-52 of D3) would render air distribution tube **128** of D2 unsuited for its intended purpose of distributing the air stream uniformly across the width of the cylindrical stencil and embossable fabric to form a predetermined pattern of air embossed features on the fabric corresponding to the patterned apertures in the stencil. If the above-described air redirecting element taught in D3 were utilized in the system of D2, only discrete, widely spaced slit-like portions of the stencil pattern would be impinged by the sheet-like air streams emitted from the air redirecting element of D3, so that only discrete, widely spaced slit-like portions of the stencil patterns would be embossed upon the fabric. Because the desired result of the systems and methods disclosed in D2 is to produce a

predetermined embossed pattern corresponding to the pattern of apertures in the stencil (see column 1, line 55 and column 2, lines 42-48 of D2), such a result would be clearly undesirable and unacceptable (and also would render a substantial portion of the apertures in the stencil disclosed non-functional and superfluous) and thus would effectively serve to teach away from incorporating the air redirecting element of D3 in the air tube of D2 along the lines suggested in the Written Opinion. In view of the above remarks, it is believed that the objection to the above-mentioned claims as lacking an inventive step over D2 in view of D3 has been traversed, and reconsideration and withdrawal of the objection is respectfully requested.

New claims

New claim 111 depends from claim 1 and recites subject matter formerly recited in claim 1.

New claim 112 depends from claim 104 (formerly claim 109) and recites subject matter formerly recited in claim 109 (now renumbered as claim 104).

Conclusion

On the basis of the amendments and remarks herein, it is believed that the novelty, inventive step, and industrial applicability of the claims has now been clarified. Substantive examination is respectfully requested.

A favorable Written Opinion and response is requested.

If, for any reason, this response does not place the application in condition for issuing a favorable International Preliminary Examination Report, applicants request issuance of a further Written Opinion and an opportunity to respond thereto prior to issuance of the International Preliminary Examination Report. Should there be insufficient time available for issuance of a further Written Opinion, applications request the IPEA to initiate a telephone

interview at applicants expense, and an opportunity to file a supplemental response to the previous Written Opinion by return fax, pursuant to PCT Article 34(2).

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some embodiments, utilize air lances for directing a stream of air onto the embossable surface of a fabric that have at least one nozzle having a characteristic orifice dimension substantially less than that of conventional air lance nozzles. The disclosed air embossing systems can also include air lances having nozzles positioned in close proximity to the embossable surface of a fabric being embossed, substantially closer than is typical for air lances employed in conventional air embossing systems. Air lances provided according to the invention can also include one or more nozzles having a characteristic orifice dimension that is substantially less than a characteristic length of the nozzles. Certain air lances provided according to the invention can also include one or more nozzles in the shape of an elongated slit oriented, with respect to the air lance, so as to be positioned across essentially the entire width of a fabric being embossed with the air lance. The invention also provides air lances for use in embossing fabrics that can include a nozzle-forming component that is separable from the main body of the air lance and that enables the nozzle(s) of the air lance to be positioned within close proximity to the fabric, when the air lance is in operation, and that also can act to redirect air flowing within the air lance such that it is emitted from the nozzle(s) so that a substantial fraction of the air stream is directed essentially perpendicular to the surface of the fabric being embossed. Yet other air lances disclosed include therein one or more baffles or air redirecting elements, which serve to deflect air flowing within the air lance so that it passes through the nozzle(s) and is directed onto the embossable surface of the fabric at an angle that is substantially greater, with respect to the longitudinal axis of the air lance, than the angle of an air stream emitted from a nozzle of an essentially equivalent air lance, except excluding the air redirecting element or baffle. Some of the air lances described according to the invention can include a combination of several or all of the above described features.

In one embodiment, a system for air embossing a surface of an embossable fabric is disclosed. The system comprises a stencil having a first surface and a second, fabric-facing surface that is positionable adjacent and in spaced proximity to the embossable surface of the fabric during air embossing. The system further comprises an air lance comprising a main body portion and including at least one nozzle. The nozzle is constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface. The air lance is secured within the system to maintain the nozzle in a fixed, predetermined position relative to the first surface of the stencil during operation. The air lance is positioned such that the nozzle is positioned so that at least a portion thereof, which is

closest to the stencil, is separated from the first surface of the stencil by a first distance, when the system is in operation. The air lance is also positioned such that the smallest distance separating the main body portion of the air lance from the first surface of the stencil exceeds the first distance.

In another embodiment, a system for air embossing a surface of an embossable fabric is disclosed. The system comprises a stencil and an air lance including at least one nozzle thereon. The nozzle is constructed and positioned to direct a flow of air through the stencil and onto the embossable surface of the fabric, when the system is in operation. The system further comprises a substantially smooth support surface comprising a cylindrical roller constructed and arranged to support the underside of the fabric during air embossing of the embossable surface of the fabric with the system. The cylindrical roller is positioned directly beneath and spaced apart from the nozzle such that a stream of air exiting the nozzle is directed to impinge upon the fabric at a location where the fabric is adjacent to and in contact with the cylindrical roller, when the system is in operation.

In another aspect, an air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric is disclosed. The air lance comprises a conduit having at least one opening therein and at least one orifice forming at least one nozzle. The nozzle is constructed and positioned to direct a stream of air through the stencil and onto the embossable surface of the fabric when the air lance is in operation. The nozzle has a characteristic orifice dimension not exceeding about 0.05 inch.

In another embodiment, an air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric is disclosed. The air lance comprises a conduit having at least one inlet opening therein and at least one orifice forming at least one nozzle. The nozzle is constructed and positioned to direct a stream of air through the stencil and onto the embossable surface of the fabric when the air lance is in operation. The nozzle has a characteristic orifice dimension not exceeding a maximum characteristic length of the nozzle.

In yet another embodiment, an air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric is disclosed. The air lance comprises a conduit having an elongated main body portion with at least one inlet opening and at least one outlet opening therein. The air lance further includes a nozzle-forming component connected to the main body portion and extending along a substantial fraction of

the length of the main body portion. The nozzle-forming component includes at least one orifice therein forming a nozzle. The nozzle is in fluid communication with the outlet opening of the main body portion and is constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface of the fabric when the air lance is in operation. The nozzle-forming component is shaped and positioned so that the nozzle in the nozzle-forming component is separated from a first surface of the stencil onto which air is impinged by a distance that is substantially less than a distance separating the first surface of the stencil and the outlet opening in the main body portion of the conduit.

In yet another embodiment, an air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric is disclosed. The air lance comprises an elongated tubular conduit having at least one inlet opening therein and at least one internal support strut attached therein. The support strut is constructed and positioned within the conduit to resist expansion of the conduit when the air lance is in operation. The air lance includes at least one orifice in the shape of an elongated slit forming at least one nozzle. The nozzle is constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface of the fabric, when the air lance is in operation.

In another embodiment, an air lance for directing air through a stencil onto a surface of an embossable fabric for air embossing the fabric is disclosed. The air lance comprises a conduit having at least one opening therein and at least one orifice forming at least one nozzle. The nozzle is constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface of the fabric when the air lance is in operation. The air lance further comprises at least one air redirecting element constructed and positioned with respect to the nozzle so that the fractional amount of the stream of air directed through the opening in the stencil essentially perpendicular to the embossable surface of the fabric is increased with respect to a fractional amount of a stream of air directed through the opening in the stencil essentially perpendicular to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element.

In another aspect, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises supplying a flow of air to an air lance and flowing a stream of air through at least one nozzle of the air lance so that essentially the entire stream of air is directed towards a surface of a stencil facing and adjacent the nozzle at an angle of at least

about 45 degrees with respect to a longitudinal axis of the air lance. The method further comprises passing the stream of air through at least one opening in the stencil and impinging the stream of air onto the embossable surface of the fabric, thereby embossing the embossable surface of the fabric.

In another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises supplying a flow of air to an elongated air lance including one or more nozzles positioned along a substantial fraction of the length of the air lance. The method further comprises flowing a stream of air through the one or more nozzles such that the air velocity through the one or more nozzles is essentially constant along the substantial fraction of the length of the air lance. The method further includes passing the stream of air through at least one opening in the stencil and impinging the stream of air onto the embossable surface of the fabric, thereby embossing the embossable surface of the fabric.

In yet another embodiment, a method for embossing a surface of an embossable fabric is disclosed. The method comprises supplying a flow of air to an air lance, flowing a stream of air through at least one nozzle of the air lance so that the velocity of the air exiting the nozzle is at least about 12,000 ft/min, passing the stream of air through at least one opening in the stencil, impinging the stream of air onto the embossable surface of the fabric, and embossing the embossable surface of the fabric with a predetermined pattern of embossed features.

In another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises supplying a flow of air to an air lance, flowing a stream of air through at least one nozzle of the air lance, rotating a cylindrical stencil disposed around at least a portion of the air lance at a first speed, passing the stream of air through at least one opening in the rotating stencil, moving the fabric adjacent to an outer surface of the stencil at a second speed that is different from the first speed of the rotating stencil, impinging the stream of air onto the embossable surface of the fabric, and embossing the embossable surface of the fabric with a predetermined pattern of embossed features.

In another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises positioning at least a portion of at least one nozzle of an air lance within a first separation distance from a first surface of a stencil, positioning a main body portion of the air lance so that the smallest distance separating the main body portion from the first surface of the stencil exceeds any distance separating the nozzle from the first

surface of the stencil, forming a stream of air with the air lance by passing air through the nozzle of the air lance, and directing the stream of air through at least one opening in the stencil and onto the embossable surface of the fabric to form a predetermined pattern of embossed features.

In yet another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises positioning a substantially smooth support surface comprising a cylindrical roller directly beneath and spaced apart from the nozzle of the air lance. The method further comprises supporting the underside of the embossable fabric with the cylindrical roller and directing a stream of air with the nozzle through a stencil and onto the embossable surface of the fabric such that the stream of air impinges upon the fabric at a location where the fabric is adjacent to and in contact with the cylindrical roller.

In yet another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises directing a stream of air though a stencil and onto the embossable surface of the fabric with an air lance including a conduit, having at least one inlet opening therein, and at least one orifice forming at least one nozzle having a characteristic orifice dimension not exceeding about 0.05 inch.

In another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including a conduit, having at least one inlet opening therein, and at least one orifice forming at least one nozzle having a characteristic orifice dimension not exceeding a maximum characteristic length of the nozzle.

In yet another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises directing a stream of air through a stencil an onto the embossable surface of the fabric with an air lance including a conduit, and a nozzle forming component including at least one orifice therein forming a nozzle that is in fluid communication with the outlet opening in the main body portion. The nozzle forming component is shaped and positioned to extend along a substantial fraction of the length of the main body portion and so that the nozzle in the nozzle forming component is separated from a first surface of the stencil, onto which the stream of air is impinged, by a distance that is substantially less than a distance separating the first surface of the stencil and the outlet opening in the main body portion of the conduit.

In another aspect, in a system for air embossing an embossable fabric, means are

disclosed for directing a stream of air onto the embossable surface of the fabric from a distance of no more than about 0.75 inch, with at least one cross-sectional dimension of the air stream being no more than about 0.2 inch at its source.

In yet another aspect, an air embossing system for embossing a surface of an embossable fabric is disclosed. The air embossing system comprises an elongated conduit extending across and substantially parallel to the embossable fabric and further includes means for redirecting air flowing along the length of the conduit so that essentially all of the air flow exits from at least one outlet opening in the conduit towards the fabric in a direction making an angle of at least about 45 degrees with respect to the longitudinal axis of the elongated conduit, with the means comprising a series of baffles shaped and positioned to intercept and deflect the air flow.

In another embodiment, a method for embossing a surface of an embossable fabric is disclosed. The method comprises directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including an elongated tubular conduit. The conduit has at least one inlet opening therein, at least one internal support strut attached therein, which support strut is constructed and positioned within the conduit to resist expansion of the conduit when the air lance is in operation, and at least one orifice in the shape of an elongated slit forming at least one nozzle.

In yet another embodiment, a method for air embossing a surface of an embossable fabric is disclosed. The method comprises directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including a conduit, the air lance having at least one inlet opening therein, at least one orifice forming at least one nozzle, and at least one air redirecting element constructed and positioned with respect to the nozzle so that the fractional amount of the stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric is increased with respect to a fractional amount of a stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element.

Other advantages, novel features, and objects of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings, which are schematic and which are not intended to be drawn to

scale. In the figures, each identical, nearly identical, or closely similar component that is illustrated in various figures is represented by a single numeral. For purposes of clarity, not

embodiments such as that illustrated, outlet opening 224 comprises an elongated slot extending along a substantial portion of the length of the main body portion, as illustrated more clearly in FIGs. 8a - 8f. Main body portion 212 may also be stabilized against internal pressure by including one or more internal support struts 226 along its length, which can be welded or otherwise attached to main body portion 212 and can extend across outlet slot 224 in order to resist expansion of main body portion 212 when the air lance is in operation.

Typically, when in operation, the inlet of air lance 210 is attached to an air supply 114, as shown above in FIG. 3, which preferably comprises a variable speed blower able to provide a user-adjusted volumetric flow rate of air to air lance 210. Typical operating pressures within air lance 210 can range from about 1 inch H_20 to about 100 inches H_20.

Nozzle forming component 214 may be formed of any suitable material, as would be apparent to those of ordinary skill in the art, and, in preferred embodiments is formed of a rigid metal. Nozzle forming component 214 spans outlet slot 224 of main body portion 212 and includes an upper curved surface 225 shaped to conform to the contour of the outer surface of main body portion 212. Nozzle forming component 214 may be attached to main body portion 212 by any variety of means apparent to those of ordinary skill in the art. In the illustrated embodiment, nozzle forming component 214 is removably attached to main body portion 212 via a plurality of bolts 228 positioned along the length of the nozzle forming component on opposite sides of outlet slot 224.

Nozzle forming component 214, as illustrated, includes an internal chamber 230 therein which extends along the length of the nozzle forming component coextensive with nozzle 216. Nozzle 216 can comprise a plurality of individual holes or ports within the lower surface of nozzle forming component 214; however, in order to avoid artifacts caused by the air impermeable spaces between nozzles comprising individual apertures or orifices, in preferred embodiments, nozzle 216 comprises an elongated rectangular slit extending along a substantial fraction of the length of nozzle forming component 214 and across the width of stencil 128 and the embossable width of fabric 111, when installed in the system.

In preferred embodiments, nozzle slit 216 extends along the length of nozzle forming component 214 so that it is co-extensive with outlet slot 224 in main body portion 212 and is aligned directly beneath and parallel with the outlet slot. In the illustrated embodiment, nozzle forming component 214 extends away from main body portion 212 so that nozzle 216 is separated from outlet opening 224 by a distance of about 1.25 inches, which is sufficient to span the entirety of distance 220 separating surface 218 and surface 222, when the air lance is

CLAIMS

1. A system for air embossing a surface of an embossable fabric comprising:

a stencil having a first surface and a second fabric-facing surface that is positionable adjacent and in spaced proximity to the embossable surface of the fabric during air embossing; and

an air lance comprising a main body portion and including at least one nozzle, the nozzle being constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface, with

the air lance being secured to maintain the nozzle in a fixed, predetermined position relative to the first surface of the stencil during operation, and

the air lance being positioned such that the nozzle is positioned so that at least a portion thereof, which is closest to the stencil, is separated from the first surface of the stencil by a first distance, when the system is in operation, and so that the smallest distance separating the main body portion of the air lance from the first surface of the stencil exceeds the first distance.

2. The system of claim 1, wherein the first distance does not exceed about 0.5 inch, when the system is in operation.

3. The system of claim 2, wherein the first distance does not exceed about 0.25 inch, when the system is in operation.

4. The system of claim 3, wherein the first distance does not exceed about 0.1 inch, when the system is in operation.

5. The system of claim 4, wherein the first distance does not exceed about 0.05 inch, when the system is in operation.

6. The system of claim 5, wherein the first distance does not exceed about 0.025 inch, when the system is in operation.

7. The system of claim 6, wherein the first distance does not exceed about 0.0125 inch, when the system is in operation.

8. The system of claim 7, wherein the first distance is about 0.01 inch, when the system is in operation.

9. The system of claim 1, wherein the system further comprises adjustable air lance positioning means for enabling an operator of the system to adjust the first distance.

10. The system of claim 1, wherein at least a portion of the second fabric-facing surface of the stencil is positioned from the embossable surface of the fabric at a distance not exceeding about 0.02 inch.

11. The system of claim 10, wherein at least a portion of the second fabric-facing surface of the stencil is positioned from the embossable surface of the fabric at a distance not exceeding about 0.01 inch.

12. The system of claim 11, wherein at least a portion of the second fabric-facing surface of the stencil is positioned from the embossable surface of the fabric at a distance not exceeding about 0.005 inch.

13. The system of claim 12, wherein at least a portion of the second fabric-facing surface of the stencil is positioned from the embossable surface of the fabric at a distance of about 0.001 inch.

14. The system of claim 1, further comprising a support surface constructed and positioned to support the underside of the fabric during air embossing of the embossable surface of the fabric with the system.

15. The system of claim 14, wherein the support surface comprises a cylindrical roller.

16. The system of claim 1, wherein the stencil comprises a hollow rotatable cylinder with the air lance being at least partially disposed within the cylinder.

17. The system of claim 16, further comprising

a first drive system constructed and arranged to rotate the stencil at at least a first speed; and

a second drive system constructed and arranged to transport the fabric with respect to the position of the air lance at at least a second speed different from the first speed.

18. The system of claim 16, wherein the at least one nozzle has a characteristic orifice dimension less than about 0.2 inch.

19. The system of claim 18, wherein the at least one nozzle has a characteristic orifice dimension not exceeding a maximum characteristic length of the at least one nozzle.

20. The system of claim 19, wherein the air lance comprises a conduit having a main body portion with an inlet opening in at least one end thereof and at least one outlet opening in a side wall of the main body portion forming the at least one nozzle.

21. The system of claim 18, wherein the air lance comprises a conduit, forming the main body portion, with an inlet opening in at least one end thereof and at least one outlet opening in a side wall of the main body portion,

wherein the air lance includes a nozzle-forming component, which nozzle-forming component includes at least one orifice therein forming the at least one nozzle, wherein the nozzle in the nozzle-forming component is in fluid communication with the outlet opening in the main body portion of the conduit and is constructed and positioned to direct a stream of air through the stencil and onto the embossable surface of the fabric, when the air lance is in operation, and

wherein the nozzle forming component is shaped and positioned so that the nozzle in the nozzle-forming component is separated from the first surface of the stencil by a distance that is substantially less than a distance separating the first surface of the stencil and the outlet opening in the main body portion of the conduit, when the air lance is in operation.

22. The system of claim 18, wherein the at least one nozzle comprises an orifice in the shape of an elongated slit.

23. The system of claim 18, wherein the air lance includes at least one air redirecting element constructed and positioned with respect to the at least one nozzle so that the fractional amount of the stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric, when the air lance is in operation, is increased with respect

to a fractional amount of a stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element.

24. The system of claim 21, wherein the air lance includes at least one air redirecting element constructed and positioned with respect to the at least one nozzle so that the fractional amount of the stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric, when the air lance is in operation, is increased with respect to a fractional amount of a stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element.

25. The system of claim 24, wherein the at least one air redirecting element is positioned within the nozzle forming component and upstream of the at least one nozzle.

26. A system for air embossing a surface of an embossable fabric comprising:

a stencil;

an air lance including at least one nozzle thereon, the nozzle being constructed and positioned to direct a flow of air through the stencil and onto the embossable surface of the fabric, when the system is in operation; and

a substantially smooth support surface comprising a cylindrical roller constructed and arranged to support the underside of the fabric during air embossing of the embossable surface of the fabric with the system; with

the cylindrical roller being positioned directly beneath and spaced apart from the nozzle such that a stream of air exiting the nozzle is directed to impinge upon the fabric at a location where the fabric is adjacent to and in contact with the cylindrical roller, when the system is in operation.

27. The system of claim 26, wherein the cylindrical roller is rotated, when the system is in operation.

28. The system of claim 27, further comprising a surface cleaning element that is constructed and positioned to contact a rotating outer cylindrical surface of the cylindrical roller along substantially the entire length of the roller that is in contact with the underside of

the fabric thereby removing any dirt and debris from the outer cylindrical surface, when the system is in operation.

29. The system of claim 28, wherein the cleaning element comprises a scraping blade.

30. An air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric comprising:

a conduit having at least one inlet opening therein; and

at least one orifice forming at least one nozzle, the nozzle being constructed and positioned to direct a stream of air through the stencil and onto the embossable surface of the fabric, when the air lance is in operation, with

the nozzle having a characteristic orifice dimension not exceeding about 0.05 inch.

31. The air lance of claim 30, wherein the at least one nozzle has a characteristic orifice dimension not exceeding about 0.01 inch.

32. The air lance of claim 31, wherein the at least one nozzle has a characteristic orifice dimension not exceeding about 0.005 inch.

33. The air lance of claim 32, wherein the at least one nozzle has a characteristic orifice dimension not exceeding about 0.001 inch.

34. The air lance of claim 30, wherein the at least one nozzle has a characteristic orifice dimension not exceeding a maximum characteristic length of the nozzle.

35. The air lance of claim 30, wherein the conduit includes a main body portion having the at least one inlet opening in at least one end thereof and at least one outlet opening in a side wall of the main body portion,

wherein the air lance includes a nozzle-forming component, which nozzle-forming component includes the at least one orifice therein forming the at least one nozzle, wherein the nozzle in the nozzle-forming component is in fluid communication with the outlet opening in the main body portion of the conduit and is constructed and positioned to direct a stream of air through the stencil and onto the embossable surface of the fabric, when the air lance is in operation, and

wherein the nozzle forming component is shaped and positioned so that the nozzle in the nozzle-forming component is separated from a first surface of the stencil by a distance that is substantially less than a distance separating the first surface of the stencil and the outlet opening in the main body portion of the conduit, when the air lance is in operation.

36. The air lance of claim 30, wherein the at least one nozzle comprises an orifice in the shape of an elongated slit.

37. The air lance of claim 30, wherein the air lance includes at least one air redirecting element constructed and positioned with respect to the at least one nozzle so that the fractional amount of the stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric, when the air lance is in operation, is increased with respect to a fractional amount of a stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element.

38. An air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric comprising:

a conduit having at least one inlet opening therein; and

at least one orifice forming at least one nozzle, the nozzle being constructed and positioned to direct a stream of air through the stencil and onto the embossable surface of the fabric, when the air lance is in operation, with

the nozzle having a characteristic orifice dimension not exceeding a maximum characteristic length of the nozzle.

39. The air lance of claim 38, wherein the maximum characteristic length of the nozzle exceeds the characteristic orifice dimension by a factor of at least about 2.

40. The air lance of claim 39, wherein the maximum characteristic length of the nozzle exceeds the characteristic orifice dimension by a factor of at least about 3.

41. The air lance of claim 40, wherein the maximum characteristic length of the nozzle exceeds the characteristic orifice dimension by a factor of at least about 4.

42. The air lance of claim 38, wherein the conduit includes an elongated main body portion and wherein the at least one orifice forming the at least one nozzle comprises at least one outlet opening in a side wall of the main body portion of the conduit.

43. The air lance of claim 42, wherein the elongated main body portion of the conduit includes a plurality of orifices comprising a plurality of nozzles.

44. The air lance of claim 43, wherein the plurality of orifices are essentially circular in shape.

45. The air lance of claim 42, wherein the elongated main body portion of the conduit includes an elongated slit comprising a slit-shaped nozzle.

46. The air lance of claim 45, wherein the elongated slit has a width that is essentially constant along its length.

47. The air lance of claim 45, wherein the conduit is tubular in shape having a first and a second end and having one inlet opening in the first end thereof with the second end thereof sealed, and wherein the width of the elongated slit varies along a length of the main body portion such that the width is greatest in a region of the slit closest to the first end of the conduit and smallest in a region of the slit closest to the sealed second end of the conduit.

48. The air lance of claim 42, wherein the characteristic length of the at least one nozzle is essentially equal to the wall thickness of the main body portion in which the at least one outlet opening is formed.

49. The air lance of claim 48, wherein the wall thickness does not exceed about 1/8 inch.

50. The air lance of claim 42, wherein the air lance includes at least one air redirecting element constructed and positioned with respect to the at least one nozzle so that the fractional amount of the stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric, when the air lance is in operation, is increased with respect to a fractional amount of a stream of air directed through the stencil essentially perpendicular

to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element.

51. The air lance of claim 50, wherein the at least one air redirecting element is positioned inside the main body portion of the conduit.

52. The air lance of claim 51, wherein a substantial fraction of the characteristic length of the at least one nozzle comprises a length of the at least one air redirecting element as measured in a direction essentially perpendicular to a longitudinal axis of the main body portion of the conduit.

53. The air lance of claim 38, wherein the conduit includes a main body portion having the at least one inlet opening in at least one end thereof and at least one outlet opening in a side wall of the main body portion,

wherein the air lance includes a nozzle-forming component, which nozzle-forming component includes the at least one orifice therein forming the at least one nozzle, wherein the nozzle in the nozzle-forming component is in fluid communication with the outlet opening in the main body portion of the conduit and is constructed and positioned to direct a stream of air through the stencil and onto the embossable surface of the fabric, when the air lance is in operation, and

wherein the nozzle forming component is shaped and positioned so that the nozzle in the nozzle-forming component is separated from a first surface of the stencil by a distance that is substantially less than a distance separating the first surface of the stencil and the outlet opening in the main body portion of the conduit, when the air lance is in operation.

54. An air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric comprising:

a conduit having an elongated main body portion with at least one inlet opening and at least one outlet opening therein; and

a nozzle-forming component connected to the main body portion and extending along a substantial fraction of the length of the main body portion, with

the nozzle-forming component including at least one orifice therein forming a nozzle, with

the nozzle being in fluid communication with the outlet opening in the main body portion and constructed and positioned to direct a stream of air through the at least one opening in the stencil and onto the embossable surface of the fabric, when the air lance is in operation, and with

the nozzle-forming component being shaped and positioned so that the nozzle in the nozzle-forming component is separated from a first surface of the stencil onto which air is impinged by a distance that is substantially less than a distance separating the first surface of the stencil and the outlet opening in the main body portion of the conduit, when the air lance is in operation.

55. The air lance of claim 54, wherein the main body portion of the conduit is in the shape of an elongated tube and the at least one outlet opening comprises an elongated slot.

56. The air lance of claim 55, wherein the at least one orifice in the nozzle-forming component comprises an elongated slit that is essentially parallel to the elongated slot in the main body portion of the conduit.

57. The air lance of claim 56, wherein the width of slot in the main body portion of the conduit exceeds the width of the slit in the nozzle-forming component.

58. The air lance of claim 56, wherein the nozzle forming component is elongated and is disposed over the slot in the main body portion of the conduit so that the slit in the nozzle forming component and the slot in the main body portion are essentially coextensive.

59. The air lance of claim 58, wherein the length of a nozzle region of the nozzle-forming component as measured along a direction parallel to the longitudinal axis of the main body portion of the conduit is at least as great as the width of the fabric being embossed by the air lance, when the air lance is in operation.

60. The air lance of claim 57, wherein the nozzle-forming component includes a hollow chamber upstream from and essentially coextensive with the elongated slit.

61. The air lance of claim 60, wherein the chamber contains at least one air redirecting element constructed and positioned with respect to the slit so that the fractional amount of the

stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric, when the air lance is in operation, is increased with respect to a fractional amount of a stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element.

62. The air lance of claim 61, wherein the at least one air redirecting element comprises a plurality of baffling vanes disposed along essentially the entire length of the chamber, affixed to the chamber to prevent motion of the vanes, and spaced along the length of the chamber at essentially regularly spaced intervals.

63. The air lance of claim 62, wherein the vanes are oriented so that an air deflecting surface of each vane is essentially perpendicular to the longitudinal axis of the main body portion of the conduit.

64. The air lance of claim 63, wherein the thickness of each of the vanes, as measured in a direction essentially parallel to the longitudinal axis of the main body portion of the conduit, is less than the characteristic orifice dimension of the slit in the nozzle-forming component.

65. The air lance of claim 64, wherein the thickness of each of the vanes, as measured in a direction essentially parallel to the longitudinal axis of the main body portion of the conduit, is less than about 0.002 inch.

66. The air lance of claim 65, wherein the thickness of each of the vanes, as measured in a direction essentially parallel to the longitudinal axis of the main body portion of the conduit, is less than about 0.001 inch.

67. The air lance of claim 62, wherein the height of each of the vanes as measured along a direction that is essentially perpendicular to the longitudinal axis of the main body portion of the conduit exceeds a distance between each vane by a factor of at least about 2.

68. The air lance of claim 67, wherein the height of each of the vanes as measured along a direction that is essentially perpendicular to the longitudinal axis of the main body portion of the conduit exceeds a distance between each vane by a factor of at least about 3.

69. The air lance of claim 68, wherein the height of each of the vanes as measured along a direction that is essentially perpendicular to the longitudinal axis of the main body portion of the conduit exceeds a distance between each vane by a factor of at least about 4.

70. The air lance of claim 61, wherein the at least one air redirecting element comprises a monolithic baffling structure having a plurality of channels therein, the monolithic baffling structure being oriented within the chamber so that the channels are oriented with their longitudinal axes essentially perpendicular to the longitudinal axis of the main body portion of the conduit.

71. The air lance of claim 70, wherein the monolithic baffling structure comprises an insert including a plurality of honeycombed cells comprising the channels.

72. The air lance of claim 71, wherein the thickness of walls of the structure separating each of the channels is less than the characteristic orifice dimension of the slit in the nozzle-forming component.

73. The air lance of claim 72, wherein the thickness of walls of the structure separating each of the channels is less than 0.002 inch.

74. The air lance of claim 73, wherein the thickness of walls of the structure separating each of the channels is less than 0.001 inch.

75. The air lance of claim 70, wherein the height of each of the channels as measured along a direction that is essentially perpendicular to the longitudinal axis of the main body portion of the conduit exceeds a characteristic dimension of each of the channels by a factor of at least about 2, the characteristic dimension of each of the channels being defined as the largest cross-sectional dimension of each of the channels as measured along a direction essentially parallel to the longitudinal axis of the main body portion of the conduit.

76. The air lance of claim 75, wherein the height of each of the channels as measured along a direction that is essentially perpendicular to the longitudinal axis of the main body portion of the conduit exceeds a characteristic dimension of each of the channels by a factor

of at least about 3, the characteristic dimension of each of the channels being defined as the largest cross-sectional dimension of each of the channels as measured along a direction essentially parallel to the longitudinal axis of the main body portion of the conduit.

77. The air lance of claim 76, wherein the height of each of the channels as measured along a direction that is essentially perpendicular to the longitudinal axis of the main body portion of the conduit a characteristic dimension of each of the channels by a factor of at least about 4, the characteristic dimension of each of the channels being defined as the largest cross-sectional dimension of each of the channels as measured along a direction essentially parallel to the longitudinal axis of the main body portion of the conduit.

78. An air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric comprising:

an elongated tubular conduit having at least one inlet opening therein and at least one internal support strut attached therein, which support strut is constructed and positioned within the conduit to resist expansion of the conduit when the air lance is in operation; and

at least one orifice in the shape of an elongated slit forming at least one nozzle, the nozzle being constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface of the fabric, when the air lance is in operation.

79. An air lance for directing air through a stencil and onto a surface of an embossable fabric for air embossing the fabric comprising:

a conduit having at least one inlet opening therein; and

at least one orifice forming at least one nozzle, the nozzle being constructed and positioned to direct a stream of air through at least one opening in the stencil and onto the embossable surface of a fabric, when the air lance is in operation; and

at least one air redirecting element constructed and positioned with respect to the nozzle so that the fractional amount of the stream of air directed through the opening in the stencil essentially perpendicular to the embossable surface of the fabric, when the air lance is in operation, is increased with respect to a fractional amount of a stream of air directed through the opening in the stencil essentially perpendicular to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element.

80. A method for air embossing a surface of an embossable fabric comprising:

supplying a flow of air to an air lance;

flowing a stream of air through at least one nozzle of the air lance so that essentially the entire stream of air is directed towards a surface of a stencil facing and adjacent the nozzle at an angle of at least about 45 degrees with respect to a longitudinal axis of the air lance;

passing the stream of air through at least one opening in the stencil; and

impinging the stream of air onto the embossable surface of the fabric, thereby embossing the embossable surface of the fabric.

81. The method of claim 80, wherein during the flowing step the at least one nozzle is positioned so that at least a portion thereof is separated from the surface of the stencil facing and adjacent the nozzle by a distance not exceeding about 0.75 inch, such that the stream of air includes at least a portion thereof with a length between the nozzle and the surface of the stencil not exceeding 0.75 inch.

82. The method of claim 81, wherein during the flowing step the at least one nozzle is positioned so that at least a portion thereof is separated from the surface of the stencil facing and adjacent the nozzle by a distance not exceeding about 0.0125 inch, such that the stream of air includes at least a portion thereof with a length between the nozzle and the surface of the stencil not exceeding 0.0125 inch.

83. The method of claim 82, wherein during the flowing step the velocity of air exiting the at least one nozzle is at least about 12,000 feet per minute.

84. The method of claim 83, wherein during the flowing step the at least one nozzle through which the stream of air flows has a characteristic orifice dimension not exceeding 0.2 inch.

85. The method of claim 84, wherein during the impinging step at least a portion of a fabric-facing surface of the stencil is positioned from the embossable surface of the fabric at a distance not exceeding about 0.02 inch.

86. An air embossed pile fabric produced according to the method of claim 85.

87. The method of claim 85, wherein during the flowing step the stream of air flows through a nozzle-forming component removably connected to a main body portion of the air lance, wherein

the nozzle-forming component includes at least one orifice therein forming the at least one nozzle, wherein

the nozzle is in fluid communication with at least one outlet opening in the main body portion, and wherein

the nozzle forming component is shaped and positioned so that the nozzle in the nozzle-forming component is separated from the surface of the stencil facing and adjacent the nozzle by a distance that is substantially less than a distance separating the surface of the stencil facing and adjacent the nozzle and the outlet opening in the main body portion of the air lance.

88. The method of claim 87, wherein the at least one orifice forming the at lest one nozzle in the nozzle-forming component comprises an elongated slit.

89. An air embossed pile fabric produced according to the method of claim 88.

90. The method of claim 88, wherein the nozzle forming component includes at least one air redirecting element therein and wherein prior to the flowing step at least a portion of the flow of air supplied to the air lance impinges upon and is redirected by the air redirecting element from an initial air flow direction forming an angle of less than about 45 degrees with respect to the longitudinal axis of the air lance to a subsequent air flow direction forming an angle of greater than about 45 degrees with respect to the longitudinal axis of the air lance.

91. An air embossed pile fabric produced according to the method of claim 90.

92. The method of claim 90, wherein during the flowing step the velocity of the air stream flowing through the at least one nozzle is essentially constant along essentially the entire length a region of the air lance along which the nozzle is positioned.

93. An air embossed pile fabric produced according to the method of claim 92.

94. A method for air embossing a surface of an embossable fabric comprising:

supplying a flow of air to an air lance;

flowing a stream of air through at least one nozzle of the air lance so that the velocity of air exiting the nozzle is at least about 12,000 feet per minute;

passing the stream of air through at least one opening in a stencil;

impinging the stream of air onto the embossable surface of the fabric; and

embossing the embossable surface of the fabric with a predetermined pattern of embossed features.

95. The method of claim 94, wherein during the flowing step the stream of air flows through the at least one nozzle of the air lance so that the velocity of air exiting the nozzle is at least about 15,000 feet per minute.

96. The method of claim 95, wherein during the flowing step the stream of air flows through the at least one nozzle of the air lance so that the velocity of air exiting the nozzle is at least about 20,000 feet per minute.

97. The method of claim 96, wherein during the flowing step the stream of air flows through the at least one nozzle of the air lance so that the velocity of air exiting the nozzle is at least about 25,000 feet per minute.

98. A method for air embossing a surface of an embossable fabric comprising:

supplying a flow of air to an air lance;

flowing a stream of air through at least one nozzle of the air lance;

rotating a cylindrical stencil disposed around at least a portion of the air lance at a first speed;

passing the stream of air through at least one opening in the rotating cylindrical stencil;

moving the fabric adjacent to an outer surface of the stencil at a second speed that is different than the first speed of the rotating stencil;

impinging the stream of air onto the embossable surface of the fabric; and

embossing the embossable surface of the fabric with a predetermined pattern of embossed features.

99. The method of claim 98, wherein during the moving step the second speed of the fabric differs from the first speed of the rotating stencil by a factor of at least about 2.

100. The method of claim 99, wherein during the moving step the second speed of the fabric differs from the first speed of the rotating stencil by a factor of at least about 4.

101. The method of claim 98, wherein during the moving step the second speed of the fabric exceeds the first speed of the rotating stencil.

102. The method of claim 98, wherein during the moving step the second speed of the fabric is less than the first speed of the rotating stencil.

103. An air embossing system for embossing a surface of an embossable fabric comprising:

an elongated conduit extending across and substantially parallel to the embossable fabric;

means for redirecting air flow flowing along the length of the conduit so that essentially all of the air flow exits from at least one outlet opening in the conduit towards the fabric in a direction making an angle of at least about 45 degrees with respect to the longitudinal axis of the elongated conduit, with said means comprising a series of baffles shaped and positioned to intercept and deflect the air flow.

104. A method for air embossing a surface of an embossable fabric comprising:

positioning at least a portion of at least one nozzle of an air lance within a first separation distance from a first surface of a stencil;

positioning a main body portion of the air lance so that the smallest distance separating the main body portion from the first surface of the stencil exceeds any distance separating the nozzle from the first surface of the stencil;

forming a stream of air with the air lance by passing air through the nozzle of the air lance; and

directing the stream of air through at least one opening in the stencil and onto an embossable surface of the fabric to form a predetermined pattern of embossed features.

105. A method for air embossing a surface of an embossable fabric comprising:

positioning a substantially smooth support surface comprising a cylindrical roller directly beneath and spaced apart from a nozzle of an air lance;

supporting the underside of an embossable fabric with the cylindrical roller; and

directing a stream of air with the nozzle through a stencil and onto the embossable surface of the fabric such that the stream of air impinges upon the fabric at a location where the fabric is adjacent to and in contact with the cylindrical roller.

106. A method for air embossing a surface of an embossable fabric comprising:

directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including a conduit, having at least one inlet opening therein, and at least one orifice forming at least one nozzle having a characteristic orifice dimension not exceeding about 0.05 inch.

107. A method for air embossing a surface of an embossable fabric comprising:

directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including a conduit, having at least one inlet opening therein, and at least one orifice forming at least one nozzle having a characteristic orifice dimension not exceeding a maximum characteristic length of the nozzle.

108. A method for air embossing a surface of an embossable fabric comprising:

directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including a conduit, having a main body portion with at least one inlet opening and at least one outlet opening therein, and a nozzle forming component including at least one orifice therein forming a nozzle that is in fluid communication with the outlet opening in the main body portion, wherein the nozzle forming component is shaped and positioned to extend along a substantial fraction of the length of the main body portion and so that the nozzle in the nozzle forming component is separated from a first surface of the stencil, onto which the stream of air is impinged, by a distance that is substantially less than a distance separating the first surface of the stencil and the outlet opening in the main body portion of the conduit.

109. A method for air embossing a surface of an embossable fabric comprising:

directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including an elongated tubular conduit, having at least one inlet opening therein, at least one internal support strut attached therein, which support strut is constructed and positioned within the conduit to resist expansion of the conduit when the air lance is in operation, and at least one orifice in the shape of an elongated slit forming at least one nozzle.

110. A method for air embossing a surface of an embossable fabric comprising:

directing a stream of air through a stencil and onto the embossable surface of the fabric with an air lance including a conduit, having at least one inlet opening therein, at least one orifice forming at least one nozzle, and at least one air redirecting element constructed and positioned with respect to the nozzle so that the fractional amount of the stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric is increased with respect to a fractional amount of a stream of air directed through the stencil essentially perpendicular to the embossable surface of the fabric by an essentially equivalent air lance, except not including the air redirecting element.

111. The system of claim 1, wherein the first distance does not exceed about 0.75 inch, when the system is in operation.

112. The method of claim 104, wherein the first separation distance does not exceed about 0.75 inch.